Micro Autonomous Systems and Technology (MAST) Collaborative Technology Alliance:

Microsystem Vision

Dr. Joseph Mait
Sensors and Electron Devices

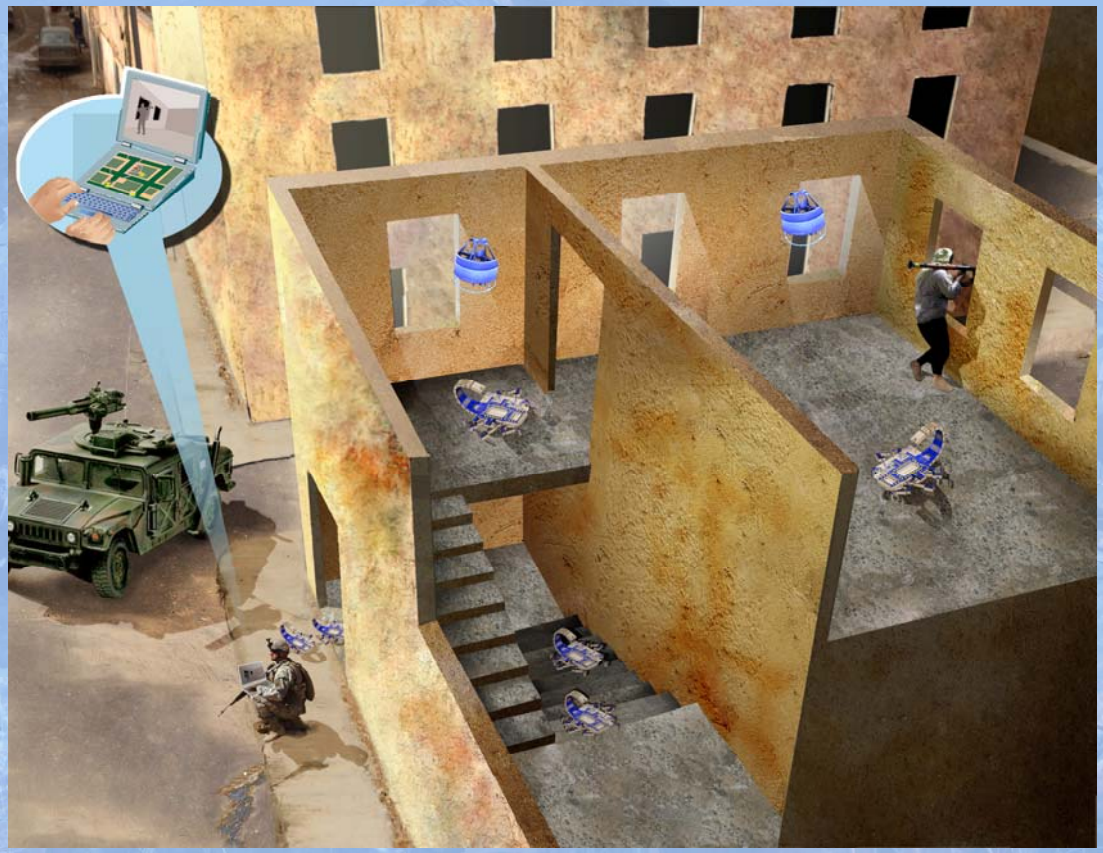
August 15, 2006

Overview

- Microsystems Vision
- CTA Vision
- Goals
- Shaping the Vision
- Scenarios
- Technical Areas
- Consortium Structure

Microsystems Vision

To enhance tactical situational awareness
in urban and complex terrain
by enabling the autonomous operation
of a collaborative ensemble of multifunctional, mobile microsystems.



CTA Vision

- To perform enabling research and transition technology in pursuit of the Microsystems Vision
- To create a critical mass of private sector and Government scientists and engineers focused on solving military technology challenges
- To support and stimulate dual-use applications to benefit commercial use

Goals

- Produce advances in fundamental science and technology
- Demonstrate and transition technology
- Develop research demonstrators for Warfighter experimentation

Shaping the Vision

- **January 30-31 Technical Workshop (Research Triangle Park NC)**
  - Invited academic & industrial community to discuss technical hurdles
  - 40+ presentations, only 3 invited (DARPA, Sandia, & AFRL)
  - 150 participants (predominantly academic)
  - Assessed the state-of-the-art in microsystem technology
- **February 14-15 Government-only Workshop (Adelphi MD)**
  - Invited representatives from DoD & government agencies to discuss technical hurdles & CTA technical foci
  - 50+ participants (1/3 non-ARL)
  - Defined technical challenges & proposed CTA structure
- **May 18-19 Program Announcement Advisory Board Meeting (Adelphi MD)**
  - Invited representatives from DoD & government agencies to review Program Announcement and provide feedback
  - ~30 participants (1/3 non-ARL)
  - Provided feedback on technical and management issues

Shaping the Vision (con't)

- **Demonstration activities**
  - Micro-Aerial Vehicle Competition and Workshop
    - September 2005, Garmisch, Germany
    - sponsored in part by ARL
    - demonstrate teleoperated operation outdoors
    - workshop focused on technology gaps
  - MAV-06, 2nd US-European Competition and Workshop on Micro Air Vehicles,
    - November 2006, Sandestin FL
    - ARL participating as Steering Committee member
    - demonstrate teleoperated maneuverability and payload drop-off outdoors
  - US-Asian Demonstration and Assessment of Micro-aerial and Unmanned Ground Vehicle Technology
    - Fall 2007, Agra, India
    - in planning

Shaping the Vision (con't)

- **Opportunity Conference**
  - Feedback is solicited from today's attendees
  - Final Program Announcement will be released September 1

Shaping the Vision: Operational Scenarios

- **Scenario #1: small unit building search**
  - Autonomous navigation in benign indoor environment with human mission control
- **Scenario #2: small unit cave search or demolished building**
  - Autonomous navigation in complex environment with human mission control
- **Scenario #3: small unit perimeter defense**
  - Autonomous navigation in complex environment with autonomous mission control

Scenario 1

- **Scenario #1: small unit building search**
  - Small number of microsystems map building interior (halls, doorways, rooms) in search of body heat, booby traps(?), and provide pictures
  - Autonomous navigation in benign indoor environment (smooth floors, stairs, quiescent air flow)
  - Human mission control

Scenario 2

- **Scenario #2: small unit cave search or demolished building**
  - Small number of microsystems map unobstructed paths in search of body heat, booby traps(?), and provide pictures
  - Autonomous navigation in complex environment (rough ground surface, unpredictable air flow)
  - Human mission control

Scenario 3

- **Scenario #3: small unit perimeter defense**
  - Small number of microsystems provide perimeter defense (threat detection, threat identification?, threat removal?)
  - Autonomous navigation in complex environment (rough ground surface, gusty wind)
  - Autonomous mission control

Technical Issues

- **Control, perception, & cognition**
  - Autonomous navigation & control
  - Sensing & processing
  - Communication
  - Mobile, distributed sentience
- **Ambulation and aeromechanics**
  - Mechanics in non-benign, complex environments
  - Propulsion & mobility actuation
- **Materials & devices**
  - Heterogeneous integration of devices
  - Mixed signal electronics
- **Platform integration**
  - Microsystem architectures
  - Subsystem interaction
  - Packaging
- **Miniature power and energy**
  - Power integration and management

The overlap and integration between these technical areas drives research.

Micro Autonomous Systems and Technology

- Microsystem Mechanics
- Processing for Autonomous Operation
- Microelectronics
- Platform Integration